State Notes

TOPICS OF LEGISLATIVE INTEREST

Fall 2022

Charging Ahead: Sustainable Transportation Revenue in the Age of Electric Vehicles

Lead Author: Tyler VanHuyse, Senior Legislative Analyst

Michael Siracuse, Senior Fiscal Analyst

Introduction

The global replacement of combustion-engine vehicles with electric vehicles (EVs) is likely coming, but the nascent plug-in hybrid electric vehicle (PHEV) and EV industries face many challenges before this mass adoption. According to a July 2022 poll, only 43% of Americans are in favor of phasing out combustion-engine cars and trucks by 2035.[1] Recent Federal and State policy may change those approval ratings. Congress passed the Inflation Reduction Act of 2022 and ended manufacturer limits on EV vehicle tax credits, making a tax credit of $7,500 available to US consumers for North American-built EVs. In Michigan, Governor Gretchen Whitmer's administration has issued an executive directive setting a goal for statewide carbon neutrality by 2050,[2] and the State's new Council on Future Mobility and Electrification (CFME) reports the State's leading automotive manufacturers are planning for 100% EV sales by 2030.

Public sentiment is not the industries' only impediment, though. The CFME also reports that "Michigan will need approximately 10,000 [direct current fast charging] (i.e., Level three) and 90,000 Level two chargers by 2030" to support the anticipated EV adoption. Michigan currently has 488 Level three charging ports and 1,804 Level two charging ports;[3] State policy could curb that problem with programs such as Charge Up Michigan, which offers significant grants to qualifying organizations for the buildout of Level three chargers in priority areas across the State.[4] These challenges represent a delay in the mass adoption of EVs, but the Federal, State, and private interest in solutions to these challenges likely will bridge the gap in the next decade or two.

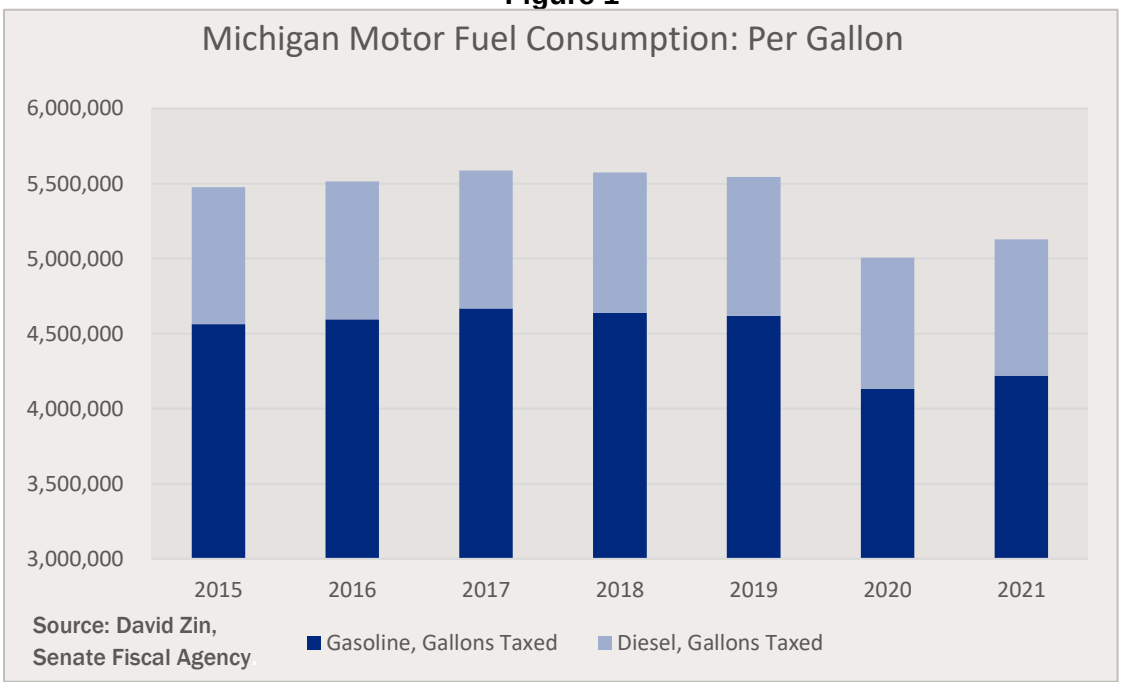
During the delay, the State has an opportunity to focus on one of the most significant policy implications that mass adoption of EVs will bring about: the eventual irrelevance of the State's fuel tax system. The system, which is the State's major source of transportation revenue, has already begun to decline in value for reasons unrelated to EVs, but EVs will lead to further revenue declines because they do not use the fuels (gas and diesel) accounted for in the current system. This paper examines the trends leading to the State's declining transportation revenues, the inroads that the State already has adopted to make up for EVs' contributions to declining revenue, and the alternative methods that the State could adopt to replace the current fuel tax system for the improvement of transportation revenues in the era of EVs.

Declining Revenue and Road Conditions

Consumption and Revenue

Gas and diesel tax revenue represent roughly half of all State spending on road construction and repair. As reflected in Figure 1, gas and diesel consumption in Michigan were down sharply in 2020 and 2021. Consumption is back up for 2022,[5] and while some revenue loss in previous years can be attributed to the COVID-19 pandemic, these losses have provided a snapshot of future revenue losses that may be coming.

Figure 1



To date, revenue from motor fuel taxes is up by 5.0% from previous years;[6] however, even a flat revenue stream will mean fewer road and bridge projects in the years and decades to come as materials and labor costs rise with inflation. New statutory language recently went into effect that will adjust the State's motor fuel taxes to accommodate for inflation, but much of the funding for road and bridge construction also comes from Federal gas tax revenue, which is not adjusted for inflation.[7] The historical value of these revenue streams is shown in Figures 2 and 3, below.

Figures 2 and 3 demonstrate one of the varied reasons why State and national infrastructure has been deteriorating for decades, which is simply that the value of revenue from a flat tax rate decreases over time. If Michigan eventually adopted statute to tax EV usage to generate replacement revenue for the gas tax, the Legislature could consider language that allows the Department of Treasury to adjust any EV tax rate, whether to accommodate for inflation or some other purpose.

Although the most recent State gas tax data do not demonstrate a significant reduction in annual revenue, national and global indicators suggest that this revenue will decline substantially within the next few decades. Over 300,000 EVs were sold in the US in 2019, the third-largest EV marketplace behind China and Europe. As of July 2021, at least 47 states and the District of Columbia offer incentives to support the deployment of EVs or alternative fuel vehicles and supporting infrastructure. A wide variety of state incentives include tax credits for EV purchases, reduced registration fees, parking incentives, or even high-occupancy vehicle lane exemptions. The Governor of California recently signed an executive order requiring all light-duty vehicles be emission free by 2035. The order already has been challenged by the Federal government; however, California has a history of requesting, and winning, waivers to establish stricter emissions standards than those required by Federal law. It is relevant to the present discussion of EV regulation in Michigan because it is an indicator of the national trend.

Currently 14 other states follow California's emission standards under Section 177 of the Federal Clean Air Act, including the nearby states of New York, Pennsylvania, and Minnesota.

Figure 2

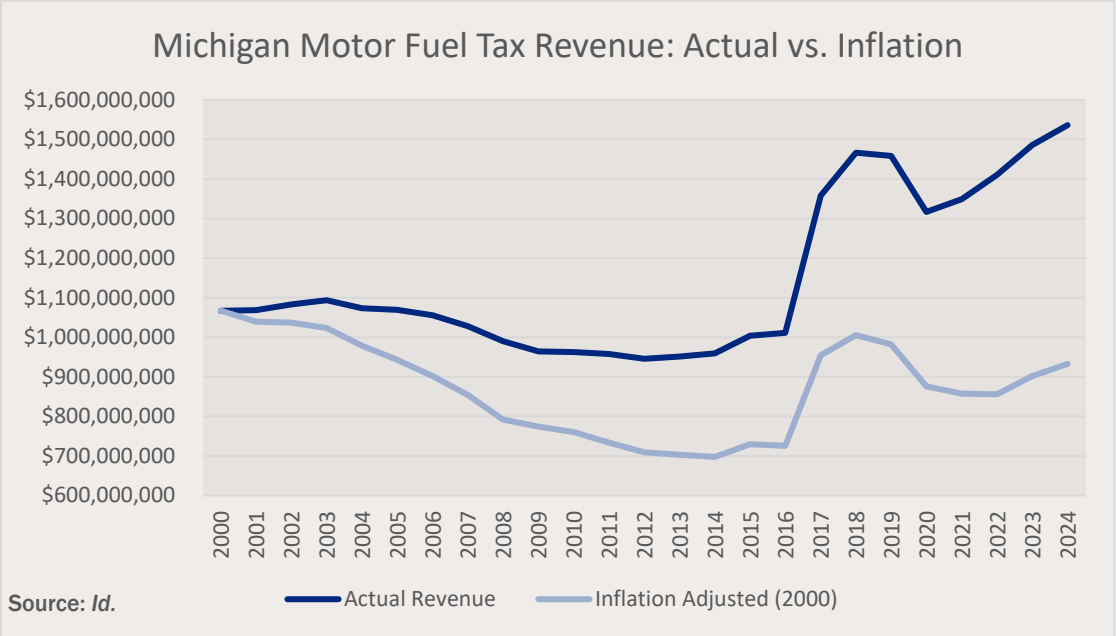
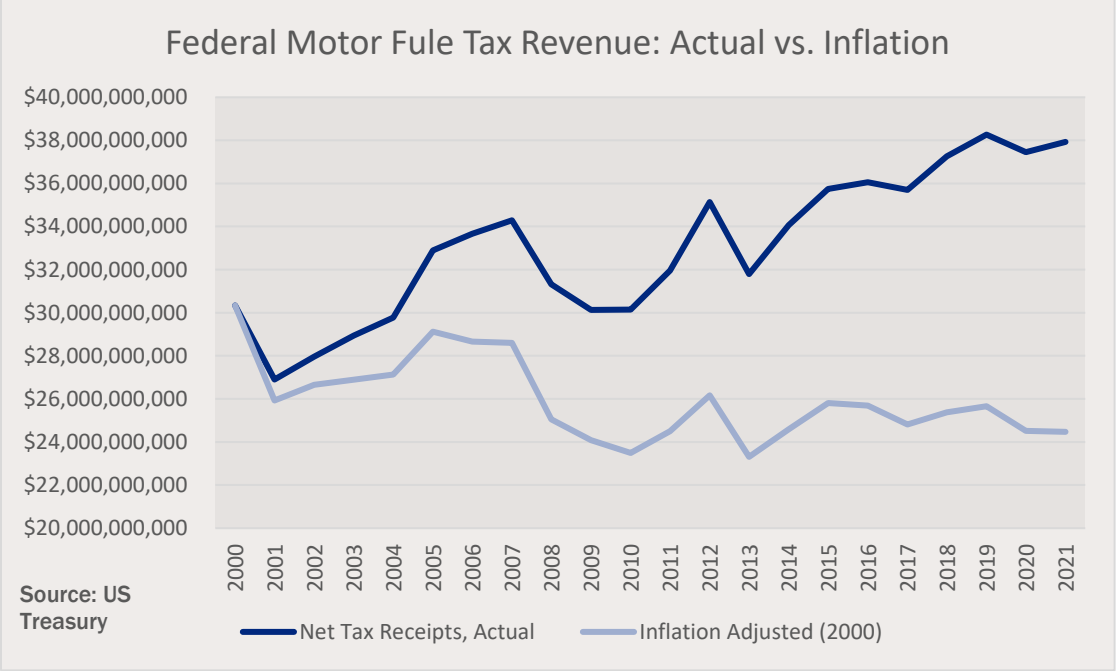


Figure 3



Inflation Costs for Road-building Materials

Inflation and growing material costs further exacerbate the declining value of transportation revenue shown above. These costs for road and bridge projects are already on the rise, and with the passage of the Infrastructure Investment and Jobs Act in 2021, all states have access to increased Federal aid for a large variety of infrastructure projects. This means that states must compete for labor and materials, such as sand (or soil), gravel, cement, concrete, steel, etc. Figures 4 and 5 demonstrate sharp increases in indices for nonresidential concrete and sand and gravel over the past 10 years.

Figure 4

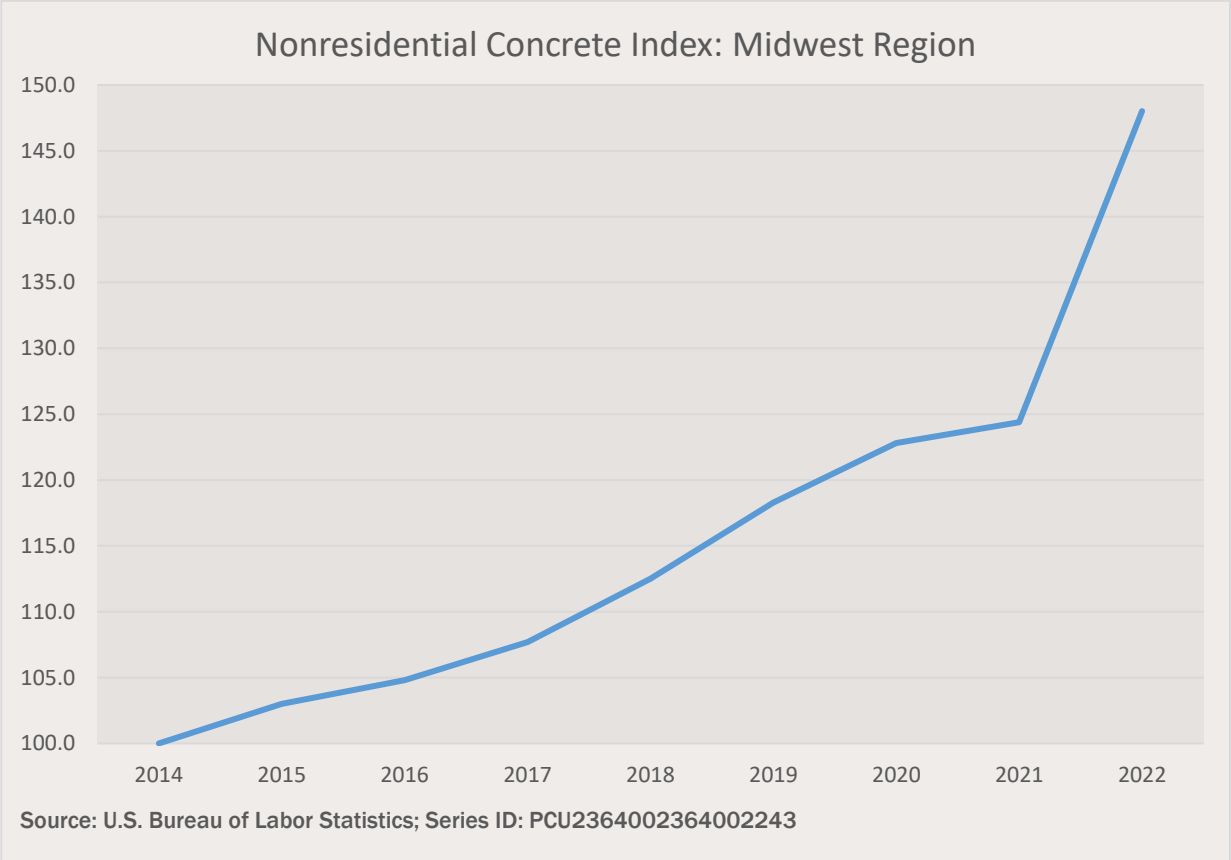
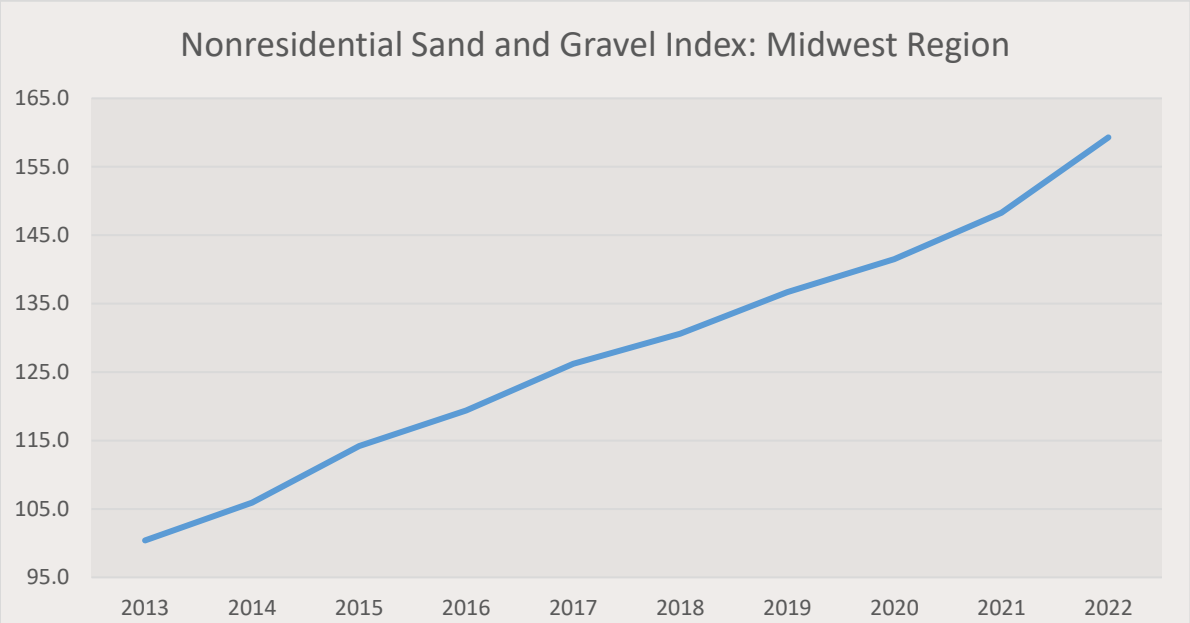


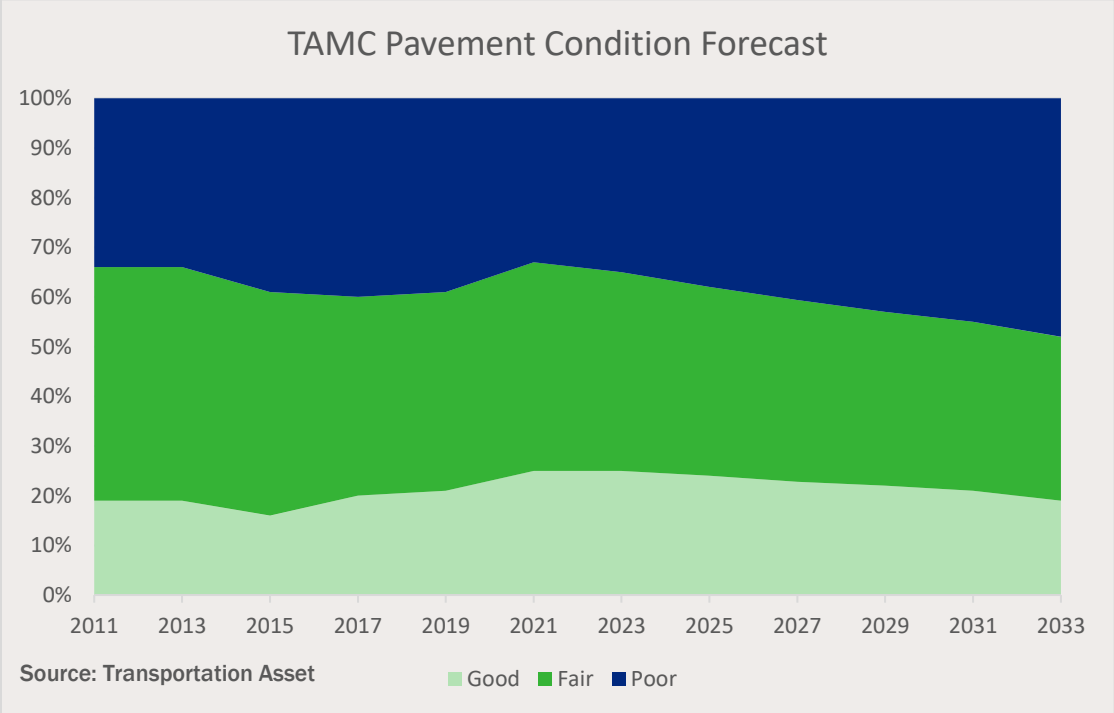
Figure 5



Source: U.S. Bureau of Labor Statistics; Series ID: WPU132101202
Road Conditions

Road Conditions

Figure 6



Source: Transportation Asset

Figure 6 is an adaptation of data taken from the Transportation Asset Management Council's dashboard on August 16, 2022. While clear gains have been made in roads in good condition since 2015, the projection for the next decade reflects a continuing decline in statewide road conditions.

The slight increase in road conditions over the past seven years can be attributed to the passage of the State's 2015 Road Funding Package and Governor Whitmer's bonding program, Rebuilding Michigan, which is a $3.5 billion bonding program investing in interstate and major highways over four years.[8] While these investments have improved the State's roadways, Figure 6 demonstrates that large, long-term investment still is needed for meaningful, sustained improvement of State and local roads.

Revenue Recovery Options

Increasing labor and materials costs, road condition projections, and decreasing transportation revenue demonstrate a significant need in Michigan's future infrastructure funding. Even without EV adoption cutting into Michigan's revenue stream from motor fuels, the State will require more investment in infrastructure to improve its roadways. The need for the State to address these present and prospective revenue shortfalls and to make changes to its current fuel tax system because of the anticipated expansion in EVs brings about an inflection point in which the State could consider future revenue recovery options.

Policymakers have developed and begun to test alternative methods to make up for the declining value of transportation revenues, such as additional EV registration fees, a mileage-based user fee (MBUF), and a tax of electricity used by EVs. This section considers the advantages and disadvantages of each alternative method and addresses the challenges that Michigan policymakers could confront when considering each method's implementation in the State.

Additional EV Registration Fees

Generally, Michigan charges annual vehicle registration fees based on the manufacturer's suggested retail price, and these fees apply to combustion-engine vehicles and EVs alike. Beginning in 2017, Michigan began to charge an additional registration fee for PHEVs and EVs, which has become a popular alternative method used by policymakers across the nation to make up for the declining value of transportation revenues. According to the National Conference of State Legislatures, 30 states prescribe additional or special registration fees for EVs, and 14 of those states do so for PHEVs.[9]

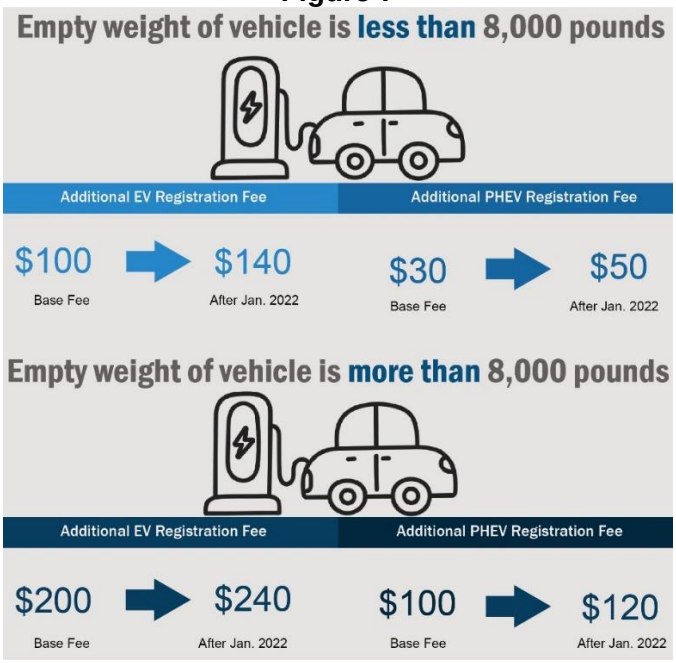
States can implement this alternative method to make up for the declining value of transportation revenues by incorporating the additional registration fee for PHEVs and EVs into their current registration fee laws and payment processes. Policymakers may calculate the additional fee based on many factors: the average amount of gas tax paid by a driver in the state, the average amount of miles driven by a driver in the state, fuel economy, and gas prices. Some believe that the method of establishing an additional EV registration fee is the least expensive and most easily administered method for making up for the declining value of transportation revenues.[10]

However, others contend that the additional EV registration fee method has significant disadvantages. Additional registrations fees could be cost-prohibitive for those with lower incomes, which could affect the equity, affordability, and adoption rates of EVs and PHEVs. In addition, this increased upfront cost could deter people from purchasing EVs or PHEVs, which could weaken the nascent EV industry and conflict with broader state and national policies encouraging the adoption of these vehicles. Policymakers could reduce the severity of these disadvantages by providing flexible payment plans for the upfront costs to registrants and allocating a portion of the additional EV registration fees to the buildout of EV infrastructure in states.

Other disadvantages of this method could include the policy's inflexibility and its disregard for the 'user-pays' principle. Additional registration fees are a static charge. They do not generate more revenue if a driver uses roadways significantly more than the average driver, unlike revenue generated by the gas excise tax, an MBUF, or taxation on the electricity used by EVs. Similarly, additional registration fees do not abide by the 'user-pays' principle, meaning that they do not base the cost of funding proportionately on one's usage. These qualities make the additional EV registration fee funding method less sustainable and less equitable than other alternative methods.

In Michigan, Public Act 174 of 2015 amended the Michigan Vehicle Code to require the Secretary of State (SOS) to charge additional PHEV and EV registration base fees at the rates described in Figure 7. In addition, the Act required the SOS to increase the fees for a PHEV by $2.50 and for an EV by $5 for each one cent increase in the State's gasoline tax, which increased by approximately seven cents in 2017 and began to increase annually with inflation in 2022. The current EV and PHEV additional registration fees are listed in Figure 7.

Figure 7



These additional registration fees are comparable to the motor fuel tax paid by combustion-engine vehicles. While the amount of motor fuel tax paid annually depends on the fuel efficiency of the vehicle, as demonstrated in tables below, similar-sized combustion-engine cars and EVs can be compared. The owner of a lighter EV currently pays an additional annual registration fee of $140, while the owner of an average combustion-engine car pays $162.16 annually in motor fuel taxes. Since Michigan statute ties the additional registration fees to the annual inflationary increases in the motor fuel tax, the owner of a lighter EV and the owner of an average combustion-engine car likely will continue to pay similar amounts toward transportation funding through these separate systems. However, this comparison looks at the actual payment made by all EV owners in Michigan and the average payment made by a combustion-engine owner in Michigan. This is worth noting since some EV owners may drive more or less than that average and, consequently, may pay more or less in transportation funding than that average, without any regard for their actual use of Michigan roadways.

Mileage-Based User Fees

Another alternative method to make up for the declining value of transportation revenues is an MBUF, also known as a road-use charge. Generally, an MBUF program establishes a per-mile rate that drivers must pay to the appropriate Federal, state, or local entity at certain times as provided by the program. There are three major components in the design of an MBUF program: the administrative procedure, the medium used to meter a driver's mileage, and the calculation of the actual per-mile rate.

Administratively, policymakers must consider the process for enrolling vehicles in the MBUF program. They must decide whether vehicle enrollment happens during the vehicle registration process, whether vehicles enroll with a state or local government, and whether the program is voluntary or compulsory. Policymakers also must consider the best way to charge drivers for their usage, focusing on the frequency of billing, how drivers will pay, and the most appropriate enforcement of the program. Other considerations include the protection of data acquired by the program, the approach to differentiating between drivers' miles driven in-state and out-of-state, and the approach to revenue sharing if multiple, contiguous states participate in the program; these last considerations depend significantly on the medium that a state uses to meter a driver's mileage.

Options for metering a driver's mileage include the use of an on-board-diagnostics II (OBD-II) port, the use of in-vehicle telematics, the use of an individual's smartphone, or regular odometer readings. An OBD-II port, which most cars made after 1996 have installed, allows external devices to access data on a vehicle's mileage, among other information that is tracked by the vehicle. These external devices can provide information on a vehicle's miles traveled to the authority administering the MBUF program. The devices can operate with or without the use of a global positioning system (GPS).

In-vehicle telematics, essentially the systems built into many modern vehicles that internally collect data from a vehicle's different components, currently provide many services to a driver, such as hands-free calling, vehicle location services, destination guidance, and vehicle diagnostics. In-vehicle telematic systems are installed by the automotive manufacturer and they offer direct data from a vehicle, which an MBUF program administrator could use to meter a driver's mileage. Smartphones also could meter a driver's miles under an MBUF, likely

through an app that the driver installs and activates while driving. The app could rely upon the GPS component of the phone to calculate the distance traveled. In addition, a driver could use a smartphone to regularly capture an image of his or her odometer and upload the image to the MBUF's administrative website. A representative of the administrator also could regularly inspect an odometer, perhaps when a vehicle's annual registration is renewed.

These media for metering a driver's mileage have varying considerations for policymakers, such as the applications, complications, and costs of each, among other things. These considerations are compared in detail in the Appendix.

Table 1

MBUF Calculations for Drives of Certain Distances in Michigan*

Type of vehicle	Average miles per gallon	2022 motor fuel tax payment for trip from Detroit to Lansing (91-mile drive)	2022 motor fuel tax payment for trip from Detroit to Marquette (455-mile drive)	MBUF payment for trip from Detroit to Lansing	MBUF Payment for trip from Detroit to Marquette
Average car	24	$1.03	$5.16	$1.27	$6.37
Light truck/van	18	$1.38	$6.88	$1.27	$6.37
Plug-in hybrid vehicle**	42	$0.59	$2.95	$1.27	$6.37
Electric vehicle	N/A	$0***	$0***	$1.27	$6.37

*The MBUF used in the table above is based on 2018 fuel tax revenue and 2018 vehicle miles traveled in Michigan, respectively divided to equal $0.014.
** The 2019 Ford Fusion Energi represents the plug-in hybrid vehicle in this chart because calculating an average MPG for these vehicles requires complex considerations and because the 2019 Ford Fusion Energi was one of the most popular cars sold in 2019.
***As mentioned, Michigan's collection of the additional registration fee is meant to substitute this motor fuel tax revenue.

Table 2

MBUF Calculation for Annual Miles Traveled in Michigan*

Type of vehicle	Average Miles per gallon	Average annual miles traveled in MI in 2019	Annual motor fuel tax payment based on 2022 rate of $.272	Annual MBUF payment based on revenue equivalency between MBUF and motor fuel tax
Average car	24	14,308	$162.16	$200.31
Light truck/van	18	14,308	216.21	200.31
Plug-in hybrid vehicle**	42	14,308	92.66	200.31
Electric vehicle	N/A	14,308	0***	200.31

*The MBUF used in the table above is based on 2018 fuel tax revenue and vehicle miles traveled in Michigan, respectively divided to equal $0.014.
**The 2019 Ford Fusion Energi represents the plug-in hybrid vehicle in this chart because calculating an average MPG for these vehicles requires complex considerations and because the 2019 Ford Fusion Energi was one of the most popular cars sold in 2019.
***As mentioned, Michigan's collection of the additional registration fee is meant to substitute this motor fuel tax revenue.

The final component of an MBUF program is the calculation of the actual per-mileage rate that a driver must pay to use the roadway. Many states that have administered or considered administering MBUF pilot programs, a few of which the paper discusses below, have established per-mile fees based on revenue equivalency with current fuel tax revenue. For example, Washington State established a flat rate of 2.4 cents per-mile during its 2020 pilot program, equivalent to the amount of fuel tax an average car in the State paid.[11] While this

basis for the calculation of a per-mile rate is common and allows states to recuperate transportation revenue, MBUF programs remain in their early stages and have significant policy flexibility concerning the per-mile fee. Table 1 and Table 2 provide examples of a MBUF calculation in Michigan. These tables also provide the assumptions made in these calculations.

Many consider an MBUF policy's fee flexibility to be its most important advantage. A per-mile fee could have many variations and dynamic price factors in the future. For example, a per-mile fee could vary by the time and location of travel to reduce traffic congestion at certain times and on certain roadways. Similarly, policymakers could establish higher per-mile fees for heavy commercial trucks that cause more damage to roadways or less fuel-efficient vehicles that contribute more to air pollution.[12] With these price dynamics, an MBUF could closely reflect each vehicle's actual use of a roadway ('user-pays' principle) and would allow policymakers to establish a fee based on target revenue. An MBUF program also is a fuel-neutral fee, which could allow policymakers to implement the program for all vehicles as the trend toward EV adoption continues to grow.

The disadvantages of an MBUF could include high administrative costs, privacy concerns for drivers, the difficulty for an interstate application of the system, and potential disincentive for people to adopt more fuel-efficient vehicles and EVs. According to a National Cooperative Highway Research Program report "motor fuel [tax collection] administrative costs are likely less than 1% of gross collections".[13] In Washington State's final report on the feasibility of an MBUF system, which recommended that the State transition to an MBUF, the estimated administrative costs for an MBUF ranged from 7% of revenue to 13% of revenue, depending on the medium used to meter a driver's mileage.[14]

Privacy concerns for drivers also depend on the medium used to measure the driver's mileage. In-person odometer readings and OBD-II port devices without GPS capabilities could reduce privacy concerns because the data collected likely would not contain driver location information; however, the use of in-vehicle telematics and smartphones for metering likely would involve information regarding the driver's location. An MBUF administrator would have to maintain strict privacy policies for the data gathered by the MBUF program. In addition, without information location associated with a driver's metered mileage, differentiating between miles driven in- and-out-of-state likely would not be possible.

Finally, some believe that an MBUF program could reduce the adoption of PHEVs and EVs because an MBUF does not incentivize fuel efficiency like current fuel taxes.[15] This reduction of EV and PHEV adoption could weaken the EV industry and conflict with broader state policies that incentivize the adoption of these vehicles. However, policymakers could use dynamic pricing as discussed above to continue to encourage fuel efficiency.

Bolstered by Federal grant support, some states have implemented this alternative method to make up for the declining value of transportation funding through pilot programs and voluntary-participation programs. Many of the programs have applied to all vehicles, EVs, PHEVs, and combustion-engine vehicles. These studies, pilots, and implemented programs provide wide-ranging insights into the potential for an MBUF program in the future.

Three Major Components of Oregon's MBUF Program (OReGO)
• Participants choose one of three private account managers that administer the program and remit taxes to ODOT. • Program's use OBD-II port devices, with or without GPS capabilities for mileage tracking. • Fee calculated for revenue neutrality with motor fuel taxes paid by a vehicle with an average MPG in the State.

Oregon studied the application of an MBUF in the State as early as 2001 and launched two pilot programs in 2007 and 2013. The Oregon Department of Transportation (ODOT) administered the 2007 pilot program, which involved 299 volunteers and equipped those volunteers' vehicles with GPS-enabled devices to meter their mileage. The year-long program showed that the MBUF concept was feasible to administer, that the per-mile fee could be dynamic to support concepts such as congestion pricing, and that drivers were concerned about the privacy and equity implications of the MBUF program.[16]

The 2013 pilot program, administered by ODOT with 88 volunteers, involved a wider range of media to meter a driver's mileage, including the use of an OBD-II port device without GPS-capabilities, an OBD-II port with GPS-capabilities, and a smartphone application. Participants could choose from four separate plans built around the media they chose, and after choosing a plan, participants received and installed a device into their vehicles and were billed monthly at a rate of 1.56 cents per mile. The pilot based this per-mile fee on the approximate amount of fuel tax paid by a vehicle with an average mile-per-gallon rating and an additional administrative cost component. The pilot program was well received by participants and considered an administrative success by ODOT, only facing a few problems, one being the technical difficulties associated with metering mileage for EVs.[17]

After successful pilot programs, the Oregon Legislature authorized ODOT to enroll an unlimited number of participants who drive EVs or vehicles that get at least 40 miles per gallon in its MBUF program in 2019. Referred to as OReGO, participants voluntarily register online for the program and, at the time of registration, participants choose one of three account managers who are private entities that have contracted with ODOT to administer the MBUF program and remit the taxes collected through the program to ODOT. Account managers provide participants with OBD-II port device, with or without GPS capabilities depending on the participant's preference, and establish methods for payment, such as prepaid wallets or regular invoices. The Department designed the per-mile fee for the program to be revenue neutral with the motor fuel taxes paid by a vehicle in the State with an average mile-per-gallon rating. As of September 13, 2022, there were 712 active participants and 775 active vehicles registered in the OReGO program.[18]

Three Major Components of the Eastern Transportation Coalition's MBUF Pilot Program
• Participants enrolled with a private account manager that administered the program and remitted taxes to the appropriate state. • Program used OBD-II port devices, with or without GPS capabilities, and a smartphone application for mileage tracking. • Fees varied by state, but drivers were charged the per-mile fee for the miles driven in their home state and an average of all other state's fees for the miles driven outside of the state.

In addition to state-centric programs, multiple states on the east and west coasts have begun to develop regional approaches to the implementation of an MBUF. The Eastern Transportation Coalition, a partnership of 17 states and the District of Columbia, established its first MBUF pilot program in 2018, focusing on passenger vehicles. The Coalition and two state transportation departments recruited 155 participants who enrolled with a private account manager and chose between three metering options: an OBD-II port with GPS capabilities, an OBD-II port without GPS capabilities, or a smartphone application. The smartphone and GPS-capable OBD-II port options allowed administrators to differentiate between mileage driven in each state and to charge according to each state's MBUF for those miles. For drivers who opted for the OBD-II port without GPS capabilities, administrators established specified percentages of mileage assumed to have occurred inside and outside a driver's home state. The administrator then charged the driver the home state's per-mile fee for the assumed in-state mile percentage and an average of all other states' per-mile fees for the assumed out-of-state percentage.

After evaluating the pilot program, the Coalition drew similar conclusions to Oregon in its original pilot program. It found that participants had decreased, but still significant, concerns for their privacy and that the concept was feasible to administer on a regional scale. The Coalition found that drivers on the east coast drove a substantial number of miles outside of their home states, more than 20% of the total mileage driven, and believed that this warranted a focus on a regionally coordinated MBUF program. The Coalition believed that the administration of the regional program was feasible for all media used to meter a driver's mileage, but that more data would be necessary to accurately assume the number of miles driven out-of-state by drivers that opt for media that do not permit location information to be collected.[19]

Taxation of Electricity Used by EVs

A third method to make up for the declining value of transportation revenues is the taxation of electricity used by EVs. Generally, this taxation could be a per-kilowatt-hour (PKH) fee based on either the electricity used to charge an EV or the electricity consumed by an EV. Each basis for the PKH fee would require policymakers to decide on a mechanism to measure the input or output of electricity and the calculation of the actual fee.

For a PKH fee based on the electricity used to charge an EV, the measurement could be made by meters installed in all charging locations, including in the homes of EV drivers and public electric vehicle charging stations. Separate meters would have to be installed for EV charging in an owner's home because current meters that measure electricity use by homeowners calculate the aggregate usage, not the usage of any singular appliance. While there is widely

accepted precedent for electricity metering, installing specific meters in all public charging stations and in EV drivers' homes to measure electricity used for charging likely would be cost prohibitive. Metering infrastructure is expensive, and the mass installation of new meters for administration of a PKH fee could significantly reduce the revenue generated by the fee. In addition, even if separate meters were installed in an EV driver's home, the driver could choose to charge the EV through an outlet metered only by his or her general home meter, potentially avoiding the PKH fee.

For a PKH fee based on the electricity used to charge an EV and for a fee based on the electricity consumed by the EV, in-vehicle telematics could provide the measurement. As described in the MBUF section, in-vehicle telematic systems are installed by the automotive manufacturer and they offer direct data from a vehicle. In-vehicle telematics in EVs continue to advance and, according to a University of California study assessing alternatives for declining transportation revenues, in-vehicle telematics could communicate with the administrator of a PKH fee program to report the electricity used to charge or consumed by an EV.[20] However, this type of communication between in-vehicle telematics and PKH program administrators would require a common platform, essentially a standardized way to communicate the data. Policymakers and automotive manufacturers would have to coordinate for the platform's functionality or mandated adoption of a platform could be necessary.

Policymakers could set the actual PKH fee at different rates depending on the desired outcome, such as the generation of revenue equivalent to current fuel taxes. Policymakers could establish a PKH fee that generated equivalent revenue by converting the State's gasoline tax into kilowatt hours (kWh) using the average gasoline fuel efficiency and average EV electricity efficiency. The PKH fee also has dynamic pricing potential, such as time-of-use charging, which many consider a significant advantage.

Other advantages of the PKH fee method could include its adherence to the 'user pays' principle and the encouragement of EV adoption and fuel efficiency. As noted above, the current fuel tax system for generating transportation revenue is based on the 'user pays' principle. The PKH fee method for recovering transportation revenue also adheres to this principle, whether a fee for charging or consumption, by requiring an EV driver to pay for the fuel used on the road. The PKH fee also encourages fuel efficiency by incentivizing drivers to purchase EVs that have a higher mile-per-kWh rating and pay less in charging or consumption fees.

Some people believe that the PKH fee method has disadvantages, such as its high administrative costs, privacy concerns, and potential for declining revenue associated with better fuel efficiency, as experienced with current fuel taxes. Administrative costs for the PKH fee, depending on the technology used for measurement of the kWh, include increased metering infrastructure or a newly developed platform for administrators of the method to communicate with EVs. A disadvantage specific to the PKH fee based on consumption of electricity requiring the use of in-vehicle telematics is the concern for privacy. Among other information, in-vehicle telematics can provide location services, and while the driver's location would not have to be shared with the administrators, some people remain concerned by the potential for the information being shared.

In Michigan, with the assumption that an average car can drive 24 miles per gallon and that the average EV uses 34.6 kilowatt-hours (kWh) per 100 miles,[21] a PKH fee based on equivalency to current transportation fuel revenue ($0.272 per gallon) would equal $0.03 PKH. Table 3 compares the application of the PKH fee for EVs alongside the current fuel tax for combustion-engine vehicles, describing them both as fuel taxes.

Table 3

PKH Calculation for Annual Miles Traveled in Michigan			
Type of vehicle	**Average miles per gallon**	**Average annual miles traveled in MI in 2019**	**Annual fuel tax payment based on 2022 rate ($0.272) and PKH Fee**
Average car	24	14,308	$162.16
Light truck/van	18	14,308	216.21
Plug-in hybrid vehicle	42	14,308	92.66**
Electric Vehicle	N/A	14,308	148.52

*The 2019 Ford Fusion Energi represents the plug-in hybrid vehicle in this chart because calculating an average MPG for these vehicles requires complex considerations and because the 2019 Ford Fusion Energi was one of the most popular cars sold in 2019.
**This amount is calculated only on the current amount of motor fuel tax paid and does not consider the total PKH fee that a PHEV would pay annually because of the complications of that calculation.

Constitutional Considerations

Of the three methods discussed above, an MBUF and PKH fee could require a constitutional amendment to make certain that the revenue generated under these systems is spent on transportation purposes. Currently, under Article IX, Section 9 of the State Constitution, 90% of taxes on motor vehicle fuels must be spent on transportation. No such guarantee exists currently for the taxation of miles driven or for kilowatt hours of electricity used on roads, meaning the revenue from a new taxation system, even if sufficient to address current and future infrastructure needs, could be siphoned off for other purposes. To ensure that the revenue from a new taxation system goes to funding for roads, a constitutional amendment could be necessary. Alternatively, legislation could be proposed to modify the definition of "motor fuel" to include electricity used to power EVs.[22] There would be no guarantee that a new tax structure would create dedicated revenue for roads long-term without these safeguards in place.

Combined Approaches

While the alternative methods described above could function as standalone systems, Michigan lawmakers also could use multiple systems in tandem. The State currently generates revenue through the collection of fuel taxes and additional EV registration fees, creating a precedent for the combination of two or more systems. Further combinations could prove valuable, offering consumers a choice and generating comparable transportation funding.

For example, the State could combine the current fuel tax system and an MBUF system. Owners of EVs could adhere to an MBUF system as described in the paper, implemented as seen fit by Michigan regulators, and owners of combustion-engine vehicles could make a choice between two systems: they could continue to pay the motor fuel tax at the pump or they could opt into an MBUF system and pay accordingly. This hybrid approach would allow

consumers to choose, which could benefit the reception of a new transportation funding system in the State.

If Michigan lawmakers instituted a PKH fee for EVs, they likely would combine the current fuel tax system and the PKH fee system by default, since the PKH fee could not apply to combustion-engine vehicles. This combination could allow regulators to introduce the PKH fee system to a subset of Michigan drivers and develop the system gradually in preparation for more drivers transitioning to EVs.

Any combination of the three methods described above and the current fuel tax system could support the future of transportation funding in Michigan. A combination of two or more also could offer consumers a choice, which could decrease the concerns of privacy for certain systems. However, policymakers and regulators would have to consider the administrative costs associated with each system, as some have significant costs at the outset.

Conclusion

Each alternative method to recover the declining value of transportation revenues is complex. The change from a motor fuel tax system will be drastic, both for policymakers and regulators, who will have to establish a manageable system, and for consumers, who will have to navigate that new system. However, policymakers and regulators have an opportunity to study and consider the value of these alternative methods during the EV industry's delayed takeoff.

Already the Michigan Legislature has tasked the Michigan Department of Transportation to produce a study by the end of the 2022-23 fiscal year that will examine the impact of EVs on transportation revenue.[23] The study also must include a feasibility analysis regarding the introduction of alternative methods to generate user-based revenue as a replacement for the current fuel tax system. This study, and further investigation by legislators in legislative sessions this decade, could help prepare Michigan for the revolutionary shift in transportation that very likely lies ahead.

Appendix – A Comparison of Mediums Used to Meter a Driver's Mileage

	Potential for Use	Complications of Use	Compliance Issues	General Costs	Regional Application
OBD-II Port	Port is not universal in all vehicles, only those made after 1996. The device could provide direct access to vehicle data.	Depending on the capacity of the device, potential for indirect reporting of mileage.	Easily removed from vehicle.	Administrative costs associated with the purchase of devices, unless device is purchased by driver.	Used with GPS capacities, could differentiate between mileage by state.
In-vehicle telematics	Prevalent in newer vehicles only. Provides direct access to vehicle data.	Limited to one vehicle, a driver's mileage cannot be tracked in another vehicle.	Impossible to remove and difficult to tamper with.	Potential administrative cost if manufacturers charge for data usage.	Can differentiate between mileage by state.
Smartphone	Widely used, but not universally. Provides direct access to miles driven.	Device can be left behind, turned off, discharged, or out of cell-range.	Potential for poor compliance.	Costs to driver to purchase a smartphone and data plan.	Can differentiate between mileage by state.
Odometer readings	Universally applicable	Can be tampered with.	Can be tampered with.	Relatively low administrative and driver cost as this could be done similar to a vehicle's registration process.	Cannot differentiate between mileage by state.

[1] Kennedy, Brian, *et al*., "Americans Divided Over Direction of Biden's Climate Change Policies", Pew Research Center Report, July 14, 2022.
[2] Executive Directive 2020-10.
[3] "Electric Vehicle Charging Station Locations", www.afdc.energy.gov/fuels/electricity_locations. Retrieved 9-12-22
[4] "Charge Up Michigan Program", Michigan Department of Environment, Great Lakes, and Energy, https://www.michigan.gov/egle. Retrieved 9-12-22
[5] Zin, David, "Motor Fuel Taxation in Michigan: Presentation to a Joint Meeting of the Senate Finance Committee and Senate Committee on Transportation & Infrastructure", March 15, 2022.
[6] Michigan Department of Transportation, "Michigan Transportation Fund Revenue: Monthly Revenue Report", July 2022.
[7] MCL 207.1008
[8] See Public Acts 174 through 180 of 2015.
[9] "Special Fees on Plug-in Hybrid and Electric Vehicles", www.ncsl.org/research/energy/new-fees-on-hybrid-and-electric-vehicles. Retrieved 9-12-22.
[10] See The Vermont Commissioner of Public Service and the Commissioner of Taxes, "A Study on Replacing Motor Fuel Tax Revenues Not Collected from Plug-In Electric Vehicles", 2013.
[11] "F.A.Q", www.waroadusagecharge.org/faqs. Retrieved on 9-12-22.
[12] Sorenson, Paul, *et al.*, "Mileage-Based User Fees for Transportation Funding: A Primer for State and Local Decisionmakers", RAND Corporation, p. 6, Fall 2012.
[13] Balducci, Patrick, *et al.* "Costs of Alternative Revenue Generation Systems", National Cooperative Highway Research Program, Report 689, p. 10, 2011.
[14] Washington State Transportation Commission, "Washington State Road Usage Charge Assessment: Final Report", p. 22, 2020.
[15] National Governors Association, "Planning for State Transportation Revenue in a Coming Era of Electric Vehicles", p. 13, 2020.
[16] Road User Fee Task Force, "Report to the Oregon Legislative Assembly", 2021.
[17] *Id.*
[18] Camaro, Bo. External Customer Relationship Manager, Oregon Office of Innovation. Retrieved September 13, 2022.
[19] I-95 Corridor Coalition, "Evaluation of the I-95 Corridor Coalition's Phase 1: Mileage Based User Fee Study; Executive Summary", 2019.
[20] Jenn, Allen, "Assessing Alternatives to California's Electric Vehicle Registration Fee", University of California, Davis, December 2018.
[21] "Average Electric Car KWh Per Mile [Results From 231 EVs]", www.ecocostsavings.com/average-electric-car-kwh-per-mile. Retrieved 9-12-22.
[22] MCL 207.1004.
[23] Public Act 166 of 2022, Art. 13, Part 2, Sec. 602.